This Track 1 Decision Document is marked “Draft” but is a final document signed by the agencies.

_______________ date 5/22/2002

DOE/ID-10921
July 2001

Site 020 Track 1 Decision Documentation Package, OU 10-08

DECISION DOCUMENTATION PACKAGE COVER SHEET

Prepared in accordance with
TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEEL

Site Description: Stained Road Near NRF

Site ID: 020 **Operable Unit: 10-08**

Waste Area Group: 10

I. SUMMARY – Physical description of the site:

Site 020 consists of stained soil areas on a dirt access road between Lincoln Boulevard and the Naval Reactor Facility (NRF). The road is stained with what appears to be an oil-like substance. The road is not currently open to general traffic. The site investigation and photographs revealed that the dirt road was stained in a scattered, intermittent pattern with an oil-like substance for a distance of approximately one-quarter mile. The stains were estimated to be 0-3 inches deep, and appeared to be contained within the dirt/gravel road surface. Vegetation was well established along the roadsides adjacent to the stains. No oil odor was detected upon inspection of the site.

This site was originally listed as part of an environmental baseline assessment in 1994 and identified as a potential new waste site in 1995. In accordance with Management Control Procedure 3448, *Reporting or Disturbance of Suspected Inactive Waste Sites*, a new site identification form was completed for this site. As part of the process, a field team wrote a site description, and collected photographs and global positioning system (GPS) coordinates for the site (E305574.617 by N722204.317). The GPS coordinate system is listed as North American Datum 27, Idaho East Zone, State Plane Coordinates. The new site identification process also included a search and review of existing historical documentation.

Interviews with INEEL personnel revealed that oils were historically collected from various onsite sources, stored in a central collection area, and subsequently sprayed on INEEL roads as a means of disposal and dust suppressant (a practice discontinued after the Toxic Substance Control Act came into affect in 1976). There was concern that the oil might have contained polychlorinated biphenyls (PCBs) from transformers. It was suspected that this dirt access road had been sprayed in this manner, and as a precautionary measure, two composite soil samples were collected on April 3, 1995 at Site 020 and analyzed for PCBs. A review of the data indicates that PCBs were not detected in either sample. The samples were not analyzed for organics, metals, radionuclides, or other hazardous constituents. A copy of the data is provided as backup in this Track 1 package.

DECISION RECOMMENDATION

II. SUMMARY - Qualitative Assessment of Risk:

There is no evidence that a source of contamination exists at this site, nor is there empirical, circumstantial, or other evidence of contaminant migration. The reliability of information provided in this report is high. Field investigations and photographs revealed no visual evidence of hazardous substances that might present a danger to human health or the environment. Therefore, the overall qualitative risk is low.

The reliability of information provided in this report is high. Field investigations and subsequent sampling results revealed no evidence of PCBs. Although the samples were not analyzed for organics, metals, radionuclides, or other hazardous constituents, the probability is very low that any hazardous substances exist at this site. Therefore, the overall qualitative risk is low.

III. SUMMARY - Consequences of Error:

False negative error:
The possibility of contaminant levels at this site being above risk-based limits is remote. Soil samples were collected in 1995 and analyzed for PCBs. Analysis of the data revealed non-detects for PCBs. Field sampling and visual observations of the soil showed no evidence of migration.

False positive error:
If further action were completed at this low risk site, funds expended could exceed the environmental benefit. Surface soil sampling and analysis for organic compounds, metals, radionuclides, and other hazardous constituents would be needed to confirm the presence or absence of contamination. Based on existing information, there is no need for further action at this site.

IV. SUMMARY - Other Decision Drivers:

There are no other decision drivers for this site.

Recommended Action:

It is recommended that this newly identified site be classified as No Further Action. Field investigations, historical process knowledge, and results of field sampling for PCBs reveal that any risk to potential receptors would be within acceptable limits. The site is located in a remote, abandoned area with no viable pathways or receptors. There is no visual evidence of hazardous contaminants. The stains appear to be contained within the road surface. Samples were collected at a depth representative of the depth of the staining, which was determined to be 0-3 inches. Vegetation adjacent to the areas of the road most visibly stained appears to be well established. Although no samples were taken for constituents other than PCBs, it is believed that this site has no significant data gaps. If hydrocarbons were present in the soil, given the length of time since the road was sprayed, the chemical composition would have been significantly changed by exposure to weathering processes such as photodegradation, volatilization, evaporation, hydrolysis, biotransformation, and climate and temperature fluctuations further reducing any likelihood that contaminants would be present today at levels above risk-based limits at this site.

Signatures:	# Pages: 16	Date: July 19, 2001
Prepared By: Marilyn Paarmann, WPI		DOE WAG Manager:
Approved By:		Independent Review:

DECISION STATEMENT (DOE RPM)	
Date Received: 3/18/02	
Disposition: The stained soil at site 020 is consistant with INEEL road maintenance practices. No further characterization or remedial action is required.	
Date: 4/02/02	# Pages: 1
Name: Kathleen Hain	Signature: Kathleen E Hain

DECISION STATEMENT
(EPA RPM)

Date Received: 9/4/01 10-08-020

Disposition:

Site is located near NRF and consists of stained soil in a roadway. Sampling for PCBs were negative. Historical practice was to road oil from a tanker truck. Although it would have been helpful to have expanded the analytical parameter list, the staining is consistent with shallow application of road oil and PCBs would be a COPC. There appears no reason to further investigate this site at this time.

Date:	9/25/01	# Pages:	1
Name:	Wayne Pierre	Signature:	Wayne Pierre

DECISION STATEMENT (IDEQ RPM)	
Date Received: September 4, 2001	

Disposition:

Site #020

Site #020 is a stained section of dirt/gravel road about one-quarter of a mile long located between NRF and Lincoln Boulevard. No oil odors were detected during inspection of the site and vegetation is well established along the roadsides adjacent to the stained section of road. Two composite samples were collected in April 1995 and analyzed for PCBs. PCBs were not detected in the samples. The state concurs this is a **no further action** site.

Date: 2/6/02	# Pages:
Name: Dean V. Nygard	Signature: Dean V. Nygard

PROCESS/WASTE WORKSHEET
SITE ID: 020

PROCESS: Stained Road Near NRF
WASTE: Oil-Like Substance

Col 1 **Processes Associated With This Site**	Col 2 **Waste Description & Handling Procedures**	Col 3 **Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process**
Dirt access road stained with an oil-like substance	Used oils were collected from INEEL onsite sources and sprayed on dirt roads as a means of disposal or dust suppression using a large truck-mounted wand sprayer. It is suspected that the stains at Site 020 were caused by this practice.	**Artifact:** Stained oil **Location:** Northern dirt access road to NRF that intersects Lincoln Blvd. **Description:** Scattered, intermittent pattern of staining on dirt access road for a distance of approximately one-quarter mile. Stains visually appear to be contained within the dirt/gravel roadway. Site showed well-established vegetation along both sides of the road where stains were most visible. No oil odor was detected.

CONTAMINANT WORKSHEET

SITE ID: 020

PROCESS: (Col 1) Stained Road Near NRE WASTE: (Col 2) Oil-like substance

Col 4 What Known/Potential Hazardous Substance/Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents	Col 7 Risk-based Concentration[a]	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (high/med/low)
Aroclor 1016	Soil	ND	8.2E+001	Low	High
Aroclor 1221	Soil	ND	2.9E+000	Low	High
Aroclor 1232	Soil	ND	2.9E+000	Low	High
Aroclor 1242	Soil	ND	2.9E+000	Low	High
Aroclor 1248	Soil	ND	2.9E+000	Low	High
Aroclor 1254	Soil	ND	2.9E+000	Low	High
Aroclor 1260	Soil	ND	2.9E+000	Low	High

a. Source: EPA Region III Risk-Based Concentration Table, 4/12/99 (Reference 2)
ND = Non-Detect
Note: The analyte 2,4,5,6-tetrachloro-m-xylene was used for surrogate recovery. Percent recovery was 96% and 102% (% recovery limits ranged from 43-124).

Question 1. What are the waste generation processes, locations, and dates of operation associated with this site?

Block 1 Answer:

Site 020 consists of stained soil areas on a dirt access road leading from NRF intersecting with Lincoln Blvd, stained with what appears to be some type of oil substance. The road is stained in a scattered intermittent pattern along an approximate one-quarter mile distance.

Interviews with INEEL personnel revealed that historically oils were collected from various onsite sources, stored in a central collection area, and subsequently sprayed on INEEL roads as a means of disposal and dust suppression. This practice was discontinued after the Toxic Substance Control Act came into affect in 1976. It is suspected that the stains at Site 020 were caused by this practice.

Block 2 How reliable are the information sources? X High _Med _Low (check one)
Explain the reasoning behind this evaluation.

Interviews with INEEL Environmental Restoration Environmental Safety and Heath (ER ES&H) personnel revealed that it was common practice to dispose of oil and control road dust on unpaved roads at the INEEL in this manner and suggested that the staining originated from this practice.

Block 3 Has this INFORMATION been confirmed? X Yes _No (check one)
If so, describe the confirmation.

Interviews were conducted with ER ES&H personnel during an environmental assessment in 1994; photographs of the site and site investigators confirm the existence of stains on the road.

Block 4 Sources of Information [check appropriate box(es) & source number from reference list]

No available information	[]	Analytical data	[]
Anecdotal	[X] 3	Documentation about data	[]
Historical process data	[]	Disposal data	[]
Current process data	[]	Q.A. data	[]
Photographs	[X] 4	Safety analysis report	[]
Engineering/site drawings	[]	D&D report	[]
Unusual Occurrence Report	[]	Initial assessment	[X] 6
Summary documents	[]	Well data	[]
Facility SOPs	[]	Construction data	[]
OTHER	[]		

Question 2. What are the disposal processes, locations, and dates of operation associated with this site? How was the waste disposed?

Block 1 Answer:

Interviews with INEEL personnel revealed that historically oils were collected from various onsite sources, stored in a central collection area, and subsequently sprayed on INEEL roads as a means of disposal and dust suppression. The typical practice was to spread the oil using a truck-mounted wand sprayer directly onto the road surface until it was well coated. This practice was discontinued after the Toxic Substance Control Act came into affect in 1976. It is suspected that the stains at Site 020 resulted from this practice.

Block 2 How reliable are the information sources? X High__Med__Low (check one)
Explain the reasoning behind this evaluation.

Interviews with ER ES&H personnel revealed that it was common practice to dispose of oil and control road dust on INEEL unpaved roads in this manner.

Block 3 Has this INFORMATION been confirmed? X Yes_No (check one)
If so, describe the confirmation.

Interviews were conducted with INEEL ER ES&H personnel during a 1994 environmental assessment confirming this practice.

Block 4 Sources of Information [check appropriate box(es) & source number from reference list]

No available information	[ ]	**Analytical data**	[ ]
Anecdotal	[X] 3	**Documentation about data**	[ ]
Historical process data	[ ]	**Disposal data**	[ ]
Current process data	[ ]	**Q.A. data**	[ ]
Photographs	[ ]	**Safety analysis report**	[ ]
Engineering/site drawings	[ ]	**D&D report**	[ ]
Unusual Occurrence Report	[ ]	**Initial assessment**	[X] 6
Summary documents	[ ]	**Well data**	[ ]
Facility SOPs	[ ]	**Construction data**	[ ]
OTHER	[ ]		

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

There is no evidence that a source exists at Site 020. Site investigations reported that the dirt access road showed visual evidence of staining; however, the cause of staining was unknown. Because of the historical practice of spraying oil on the road surface, there was concern that PCBs from transformers might have been in the oil used to spray the road between NRF and Lincoln Blvd. Two composite soil samples were collected at Site 020 on April 3,1995. The samples were collected ~1/10th mile from Lincoln Blvd in the five most heavily stained areas for a distance of ~174 ft along the road. The sample logbook reported that samples were collected at 0-3 inches in depth, the soil showed very little rock, was medium to dark brown silty clay, and no oil odor was detected. No record of field screening at the time of sampling was noted.

The soil samples were analyzed for PCBs on April 14, 1995. The data were validated at Method Validation Level B. Results of the analysis revealed non-detects for PCBs in both samples. The samples were not analyzed for organics, metals, radionuclides, or other hazardous constituents. It was determined that the potential risk was for PCB contamination, and that if other hazardous constituents were present, they would likely be at levels below risk-based limits.

Block 2 How reliable are the information sources? X High __ Med __ Low (check one) Explain the reasoning behind this evaluation.

Discussions were held with ER ES&H personnel familiar with past practices at the INEEL. Samples were representative of the depth of the stain and no oil odor was noted at time of sampling. Validated sampling and analysis results reported that PCBs were not detectable in the soil samples.

Block 3 Has this information been confirmed? X Yes __No (check one) If so, describe the confirmation.

Interviews were held with ER ES&H personnel, and data collection was noted in the sample logbook. Results were provided in the data analysis report confirming no detection of PCBs in the soil samples.

Block 4 Sources of Information [check appropriate box(es) & source number from reference list]

No available information	**[ ]**	**Analytical data**	**[X] 6**
Anecdotal	**[X] 3**	**Documentation about data**	**[X] 6,7**
Historical process data	**[ ]**	**Disposal data**	**[ ]**
Current process data	**[ ]**	**Q.A. data**	**[ ]**
Photographs	**[ ]**	**Safety analysis report**	**[ ]**
Engineering/site drawings	**[ ]**	**D&D report**	**[ ]**
Unusual Occurrence Report	**[ ]**	**Initial assessment**	**[X] 5**
Summary documents	**[ ]**	**Well data**	**[ ]**
Facility SOPs	**[ ]**	**Construction data**	**[ ]**
OTHER	**[X] 1**		

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

There is no visual evidence of migration. Site investigations reveal that the stains appear to be contained within the roadway. There is no evidence of stained or discolored soil areas beyond the roadway; photographs show well established vegetation directly adjacent to the stained areas along both sides of the road.

Block 2 How reliable are the information sources? X High __Med __Low (check one)
Explain the reasoning behind this evaluation.

Visual inspections and recent photographs of the road show that vegetation is well established along the road and there is no evidence of staining in the areas directly off the roadway.

Block 3 Has this information been confirmed? X Yes __No (check one)
If so, describe the confirmation.

Site inspections revealed no visual evidence of migration. Photographs taken in 1994 and 1999 of the site show well-established vegetation along both sides of the road in the stained areas.

Block 4 Sources of Information [check appropriate box(es) & source number from reference list]

No available information	[ ]	**Analytical data**	[X] 6
Anecdotal	[ ]	**Documentation about data**	[X] 6,7
Historical process data	[ ]	**Disposal data**	[ ]
Current process data	[ ]	**Q.A. data**	[ ]
Photographs	[X] 4	**Safety analysis report**	[ ]
Engineering/site drawings	[ ]	**D&D report**	[ ]
Unusual Occurrence Report	[ ]	**Initial assessment**	[X] 5
Summary documents	[ ]	**Well data**	[ ]
Facility SOPs	[ ]	**Construction data**	[ ]
OTHER	[ ]		

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

Interviews with INEEL personnel revealed that oils were sprayed on INEEL roads from the back of a tanker truck. A wand-type series of nozzles spread the oil directly onto the road surface in a broad spray pattern until the road was well coated. Site investigations and photographs indicate that the road is stained intermittently for a distance of one-quarter mile. The sample logbook reported that samples were collected at a depth of 0-3 inches in five of the most heavily stained areas along a ~174 ft stretch of the road.

There is no expected pattern of contamination from PCBs because sampling revealed non-detects in the soil samples collected at this site. The pattern of potential contamination for organics, metals, radionuclides or other hazardous constituents cannot be estimated without further field screening or sampling, however, it is highly unlikely that these contaminants would be present at levels above risk-based limits.

Block 2 How reliable are the information sources? _ High X Med _Low (check one) Explain the reasoning behind this evaluation.

This estimate was derived from the information contained in the sample logbook and visual appearance of the stained areas observed during the site investigations. Photographs were also used to estimate the size of the stained area.

Block 3 Has this information been confirmed? X Yes __No (check one) If so, describe the confirmation.

Sample logbook, site investigation documentation and photographs of the site provide information for this estimate. The data analysis revealed no detection of PCBs in the soil samples collected at this site.

Block 4 Sources of Information [check appropriate box(es) & source number from reference list]

No available information	**[ ]**	**Analytical data**	**[X] 6**
Anecdotal	**[ ]**	**Documentation about data**	**[X] 6,7**
Historical process data	**[ ]**	**Disposal data**	**[ ]**
Current process data	**[ ]**	**Q.A. data**	**[ ]**
Photographs	**[X] 4**	**Safety analysis report**	**[ ]**
Engineering/site drawings	**[ ]**	**D&D report**	**[ ]**
Unusual Occurrence Report	**[ ]**	**Initial assessment**	**[X] 5**
Summary documents	**[ ]**	**Well data**	**[ ]**
Facility SOPs	**[ ]**	**Construction data**	**[ ]**
OTHER	**[X] 1**		

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

Site investigations and photographs indicate that the road is stained intermittently for an approximate distance of one-quarter mile. The sample logbook reported that stains were collected at a depth of 0-3 inches in five areas showing the most staining over ~174 ft stretch of road.

There does not appear to be a source at this site or contaminated region to estimate because analysis revealed no detection of PCBs in the soil samples collected at the site. The estimated volume of contamination for organics, metals, radionuclides or other hazardous constituents cannot be estimated without further field screening or sampling; however, it is unlikely that these contaminants would be present at levels above risk-based limits.

Block 2 How reliable are the information sources? _High X Med _Low (check one)
Explain the reasoning behind this evaluation.

Sample analysis for PCBs revealed there was no source of contamination present. The estimated volume of contamination for other constituents cannot be estimated without further field screening or sampling for organics, metals, radionuclides, or other hazardous substances.

Block 3 Has this INFORMATION been confirmed? X Yes _ No (check one)
If so, describe the confirmation.

Sample analysis confirmed there was no source of contamination present for PCBs. Other hazardous constituents cannot be confirmed with existing information.

Block 4 Sources of Information [check appropriate box(es) & source number from reference list]

No available information	[ ]	**Analytical data**	[X] 6
Anecdotal	[ ]	**Documentation about data**	[X] 6,7
Historical process data	[ ]	**Disposal data**	[ ]
Current process data	[ ]	**Q.A. data**	[ ]
Photographs	[X] 4	**Safety analysis report**	[ ]
Engineering/site drawings	[ ]	**D&D report**	[ ]
Unusual Occurrence Report	[ ]	**Initial assessment**	[ ]
Summary documents	[ ]	**Well data**	[ ]
Facility SOPs	[ ]	**Construction data**	[ ]
OTHER	[X] 1		

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

The estimated quantity of hazardous substances/constituents at this site is near zero because analysis for PCBs revealed non-detects in the two composite soil samples. The estimated volume of contamination for organics, metals, radionuclides, or other hazardous constituents cannot be estimated without further field screening or sampling; however, it is highly unlikely that these contaminants would be present at levels above risk-based limits.

Block 2 How reliable are the information sources? __ High X_ Med __ Low (check one)
Explain the reasoning behind this evaluation.

Sample analysis for PCBs revealed there was no source of contamination present. The estimated volume of contamination for other constituents cannot be estimated without further field screening or sampling.

Block 3 Has this INFORMATION been confirmed? _ Yes X No (check one)
If so, describe the confirmation.

Block 4 Sources of Information [check appropriate box(es) & source number from reference list]

No available information	**[ ]**	**Analytical data**	**[X] 6**
Anecdotal	**[ ]**	**Documentation about data**	**[X] 6,7**
Historical process data	**[ ]**	**Disposal data**	**[ ]**
Current process data	**[ ]**	**Q.A. data**	**[ ]**
Photographs	**[X] 4**	**Safety analysis report**	**[ ]**
Engineering/site drawings	**[ ]**	**D&D report**	**[ ]**
Unusual Occurrence Report	**[ ]**	**Initial assessment**	**[ ]**
Summary documents	**[ ]**	**Well data**	**[ ]**
Facility SOPs	**[ ]**	**Construction data**	**[ ]**
OTHER	**[X] 1,9**		

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

There is no evidence that a hazardous substance or constituent is present at levels that require action at this site. Although there is visible staining on the road, sampling analysis revealed that no PCBs are present at detectable levels.

No field screening or sampling has been conducted at this site for organics, metals, radionuclides, or other hazardous constituents. However, given the length of time since the road may have been sprayed with oil, the chemical composition of the hydrocarbon substance could have undergone significant changes. Exposure to weathering processes such as evaporation, volatilization, photolytic loss, hydrolysis, biotransformation, and climate and temperature fluctuations could further reduce any likelihood that contaminants would be present today at levels above risk-based limits at this site.

Block 2 How reliable are the information sources? _High X_ Med _Low (check one)
Explain the reasoning behind this evaluation.

This evaluation is based on sample analysis, historical process information, site visitations, and photographs of the road stains. Stains visually appear to be contained within the road surface; vegetation adjacent to the roadside appears to be well established. Sampling analysis revealed no detection of PCBs in the composite soil samples.

Block 3 Has this INFORMATION been confirmed? X Yes _No (check one)
If so, describe the confirmation.

Laboratory analysis confirmed no detection of PCBs in the samples.

Block 4 Sources of Information [check appropriate box(es) & source number from reference list]

No available information	[ ]	**Analytical data**	[X] 6
Anecdotal	[ ]	**Documentation about data**	[X] 6,7
Historical process data	[ ]	**Disposal data**	[ ]
Current process data	[ ]	**Q.A. data**	[ ]
Photographs	[X] 4	**Safety analysis report**	[ ]
Engineering/site drawings	[ ]	**D&D report**	[ ]
Unusual Occurrence Report	[ ]	**Initial assessment**	[X] 4
Summary documents	[ ]	**Well data**	[ ]
Facility SOPs	[ ]	**Construction data**	[ ]
OTHER	[X] 1,8,9		

REFERENCES

1. DOE, 1992 Track 1 Sites: Guidance for Assessing Low Probability Sites at the INEL, DOE/ID-10390 (92), Revision 1, U.S. Department of Energy, Idaho Falls, Idaho, July.

2. EPA Regional III Risk-Based Concentration Table for PCBs; 4/12/99.

3. Interviews between Scott Lebow, Environmental Baseline Assessment team member, and Robert Montgomery, ER ES&H, EG&G Idaho, Inc. re: practice of spraying oils on INEEL dirt roads for dust suppression, July 1994.

4. Photographs of Site #020: PN94-0948-4-27A, PN94-0948-4-28A

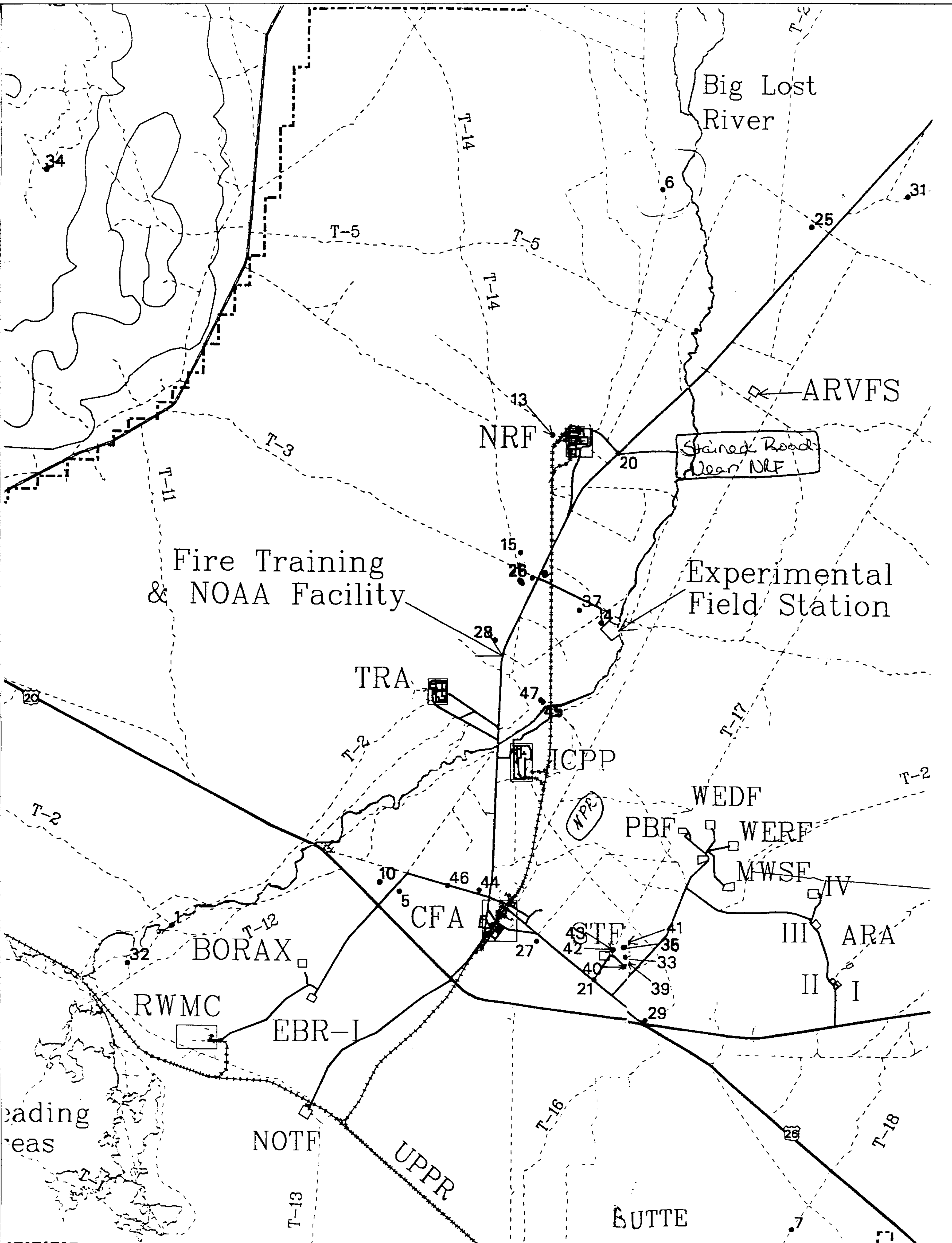
5. FY1999 WAG 10 Newly Identified Sites, Volumes I and II.

6. Memorandum from R.S. Rice to S.M. Burns re: Closure Report for the Sampling of INEL Roads for PCBs; EMS-114-94/RSR-68-95, May 22, 1995.

7. Memorandum regarding sampling of suspected PCB contaminated roads, Donna Haney, INEEL, April 3, 1995.

8. Pollard, Simon J.T., Steve E. Hrudey, and Philip M. Fedorak. Waste Management & Research, Bioremediation of Petroleum-and-Creosote-Contaminated Soils: A Review of Constraints, 1994.

9. Agency for Toxic Substances and Disease Registry, Public Health Statement, re: PCBs, June 1989.



Big Lost River
T-14
T-5
T-3
T-11
34
6
31
25
ARVFS
13
NRF
20
Stained Road
Near NRF
15
26
37
4
Fire Training
& NOAA Facility
Experimental
Field Station
28
TRA
47
45
ICPP
T-17
T-2
20
WEDF
PBF
WERF
MWSF
IV
III
ARA
II
I
10
46
44
5
CFA
STF
43
42
41
35
33
40
39
21
27
29
1
T-12
BORAX
32
RWMC
EBR-I
NOTF
UPPR
T-16
T-13
T-18
26
BUTTE
7
eading
reas

Attachment A

Photographs of Site #020

Site: 020, Stained Road Near NRF
(PN94-0948-4-27A)


Site: 020, Stained Road Near NRF
(PN94-0948-4-28A)

Attachment B

Supporting Information for Site #020

435.36
04/14/99
Rev. 03

NEW SITE IDENTIFICATION

Part A – To Be Completed By Observer

1. Person Initiating Report: Jacob Harris	Phone: 526-1877
Contractor WAG Manager: Douglas Burns	Phone: 526-4324

2. Site Title: 020, Stained Road Near NRF

3. Describe the conditions that indicate a possible inactive or unreported waste site. Include location and description of suspicious condition, amount or extent of condition and date observed. A location map and/or diagram identifying the site against controlled survey points or global positioning system descriptors shall be included to help with the site visit. Include any known common names or location descriptors for the waste site.

There is soil discoloration on the northern dirt access road to NRF that intersects Lincoln Blvd. During the August 1999 site visit, several stains were observed on the road to a depth >1 inch, however there was no oil odor detected. The GPS coordinates for this site are E305574.617 by N722204.317. The reference number for this site is 020 and can be found on the summary map as provided.

Part B – To Be Completed By Contractor WAG Manager

4. Recommendation:

☒ This site meets the requirements for an inactive waste site, requires investigation, and should be included in the INEEL FFA/CO Action Plan. Proposed Operable Unit assignment is recommended to be included in the FFA/CO.
WAG: Operable Unit:

☐ This site DOES NOT meet the requirements for an inactive waste site, DOES NOT require investigation and SHOULD NOT be included in the INEEL FFA/CO Action Plan.

5. Basis for the recommendation:

The conditions that exist at this site indicate the potential for an inactive waste site according to Section 2 of MCP-3448 Reporting or Disturbance of Suspected Inactive Waste Sites.

The basis for recommendation must include: (1) source description; (2) exposure pathways; (3) potential contaminants of concern; and (4) descriptions of interfaces with other programs, as applicable (e.g., D&D, Facility Operations, etc.)

6. Contractor WAG Manager Certification: I have examined the proposed site and the information submitted in this document and believe the information to be true, accurate, and complete. My recommendation is indicated in Section 4 above.

Name: ____________________ Signature: ____________________________ Date: ___________

9

Lockheed
Idaho Technologies Company

INTERDEPARTMENTAL COMMUNICATION

Date: May 22, 1995

To: S. M. Burns, MS 3953

From: R. S. Rice, MS 4110

Subject: CLOSURE REPORT FOR THE SAMPLING OF INEL ROADS FOR PCBS; EMS-114-94 - RSR-68-95

Attached are copies of two Reports of Analyses from Analytical Technologies, Inc. (ATI), the logbooks, and the Limitations and Validation (L&V) report for the sampling of polychlorinated biphenyls (PCBs) on Idaho National Engineering Laboratory (INEL) roads.

On April 3 and April 12, 1995, soil samples were collected from dirt roads near the East Butte, Fire Station #2, Naval Reactor Facility, and Security Training Facility. The samples were collected and analyzed according to the Abbreviated Sample and Analysis Plan for Sampling of INEL Roads for PCBs; EMS-114-94. The samples were sent to ATI under full chain of custody.

The data were validated by the Sample Management Office (SMO) at method validation level "B," as described in the SMO Standard Operation Procedure 12.1.1, "Levels of Method Validation."

A review of the data indicates that there are no PCBs present on the roadways.

If there are any questions or if you have other sampling and analysis needs, please feel free to contact me at 6-4189.

cae

Attachments

cc: (w/o Attach)
L. V. Street, MS 4110

(with Attach)
R. S. Rice File

AROCLORS
Method 8080

Lab Name: Analytical Technologies Inc.
Client Name: Lockheed Idaho Tech. Company
Client Project ID: EMS-114-94
Lab Sample ID: 95-04-028-03

Sample Matrix: Soil
Cleanup: Sulfuric Acid

Results are reported on a wet weight basis.

Sample ID

11494031PC

Date Collected: 04/03/95
Date Extracted: 04/12/95
Date Analyzed: 04/14/95

Sample Weight: 30.0 g
Final Volume: 10 mL

Analyte	Conc (ug/kg)	Detection Limit (ug/kg)
Aroclor 1016	ND	33
Aroclor 1221	ND	33
Aroclor 1232	ND	33
Aroclor 1242	ND	33
Aroclor 1248	ND	33
Aroclor 1254	ND	33
Aroclor 1260	ND	33

SURROGATE RECOVERY

Analyte	% Recovery	% Rec Limits
2,4,5,6-Tetrachloro-m-xylene	96	43 - 124

ND = Not Detected

AROCLORS

Method 8080

Lab Name: Analytical Technologies Inc.
Client Name: Lockheed Idaho Tech. Company
Client Project ID: EMS-114-94
Lab Sample ID: 95-04-028-04

Sample Matrix: Soil
Cleanup: Sulfuric Acid

Results are reported on a wet weight basis.

Sample ID

11494032PC

Date Collected: 04/03/95
Date Extracted: 04/12/95
Date Analyzed: 04/14/95

Sample Weight: 30.0 g
Final Volume: 10 mL

Analyte	Conc (ug/kg)	Detection Limit (ug/kg)
Aroclor 1016	ND	33
Aroclor 1221	ND	33
Aroclor 1232	ND	33
Aroclor 1242	ND	33
Aroclor 1248	ND	33
Aroclor 1254	ND	33
Aroclor 1260	ND	33

SURROGATE RECOVERY

Analyte	% Recovery	% Rec Limits
2,4,5,6-Tetrachloro-m-xylene	102	43 - 124

RU

ND = Not Detected

MISCELLANEOUS SAMPLE LOGBOOK

PROJECT: EMS-114-94

COC#: 2024

DATE (MM/DD/YY): 04/03/95

SAMPLERS: Rice / Haney

LOCATION: Sitewide Roads

REQUESTER: Sue Bourne

Charge #: 3XLA81130

SAMPLE ID #	TIME	ANALYSIS	CONTAINER	LOT #	PRESERV.
~~11494011PC~~		~~PCBs (8080)~~	~~250 mL WMG~~	~~03APR95 DH~~	~~4°C~~
~~11494012PC~~		~~[illegible]~~		~~03APR95 DH~~	
11494021PC	1313	PCBs (8080)	250 mL WMG	F4332040	4°C
11494022PC	1313	↓	↓	F4332040	↓
11494031PC	1347	↓	↓	F4332040	↓
11494032PC	1347	↓	↓	F4332040	↓
11494041PC	1412	↓	↓	F4332040	↓
11494042PC	1412	↓	↓	F4332040	↓

SAMPLE MATRIX

SOLID (X) LIQUID (_) SEDIMENT/SLUDGE (_)

Narrative description of the sampling event including any deviations from the sampling plan:

Stained soil on ~~[illegible]~~ 03APR95 DH several sitewide roads was identified in 1994 during the Environmental Baseline Study. Sampling was postponed until pending weather conditions. PCB-contaminated oil may have been used as a dust suppressant. Pre-job briefing held at 1235. At the east batter roads, there were no visible stains. Tried to call Sue + Bill Becker - no luck. Go to STF + collect at 5 areas of most visible stains - covered a 90' area, both sides + middle of road. Samples collected 0-2", very little rock, color reddish to dark brown, silty clay. The sample location was ~4/10th of a mile off main road + then 90' beyond. At NRF, the location is ~1/10th mile from Lincoln + [illegible] + subsamples over ~174 ft area. Same procedure. Dosen smile. Go to fire station + locate stained areas - not as visible here as at other sites. Take in a 3? subsample area ~100' diameter. The last subset smelled like gear lubricant. None of the other locations had an obvious smell. Samples packaged + shipped 4/4/95. Note to customer. Notify lab.

The final two digits specifically identify the analyses requested using the codes provided by the Statistics, Reliability and Analysis Unit. See the example ID following:

Example sample number: 11494011PC

This sample ID would indicate the sample number assigned to the EMS-114-94 project. The code would indicate that the sample is for method "8080" PCBs analysis. The exact sample location will be noted in the sample log. The following samples are currently planned for this project:

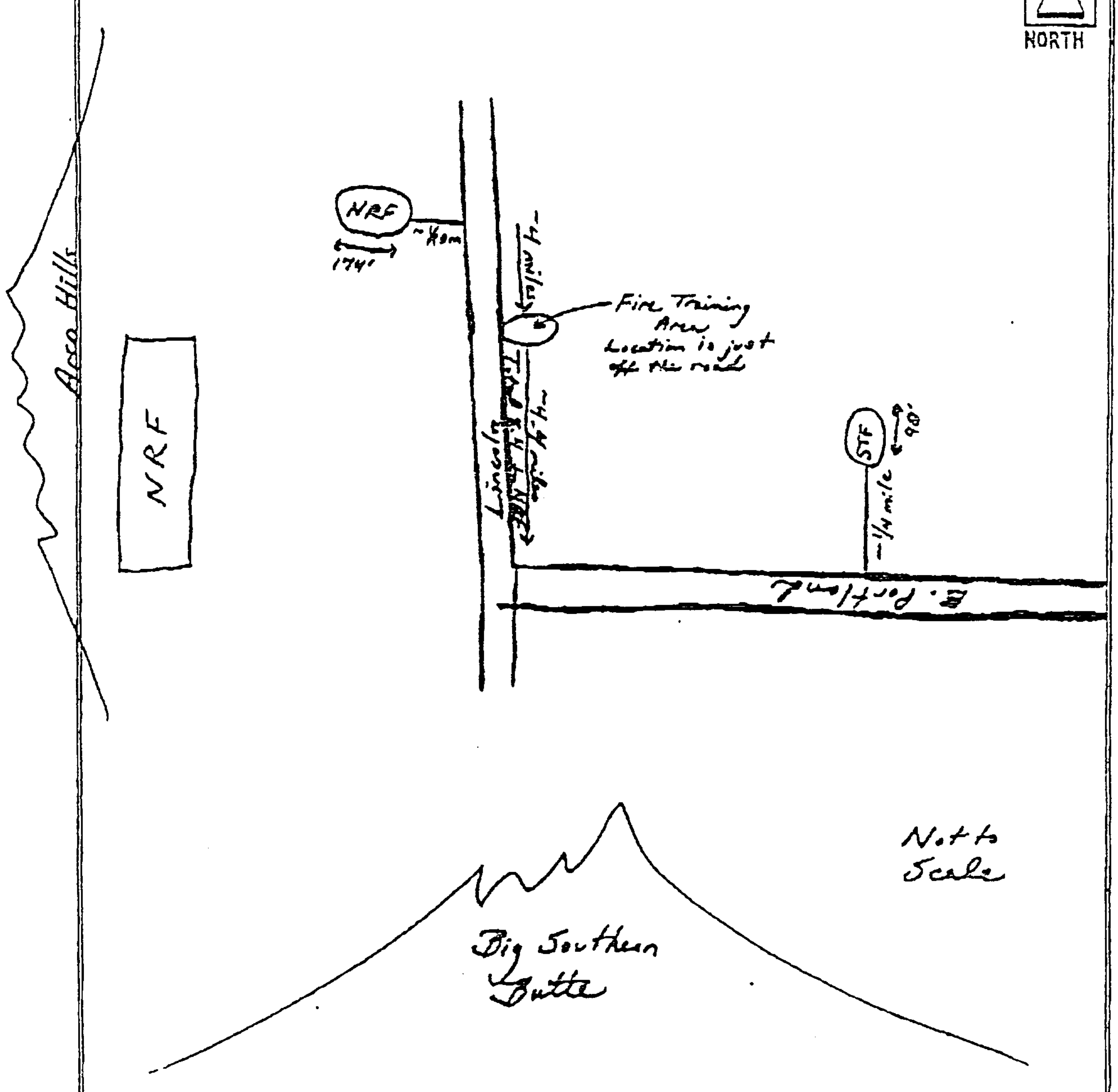
Description	Sample IDs	Sample Analyses
East Butte Road	11294011PC	PCBs ✓
East Butte Road (Duplicate)	11294012PC	PCBs ✓
STF Road	11294021PC	PCBs ✓
STF Road (Duplicate)	11294022PC	PCBs ✓
NRF Road	11294031PC	PCBs ✓
NRF Road (Duplicate)	11294032PC	PCBs ✓
Fire Training Center Road	11294041PC	PCBs
Fire Training Road (Duplicate)	11294042PC	PCBs

2.10 Decontamination Procedures

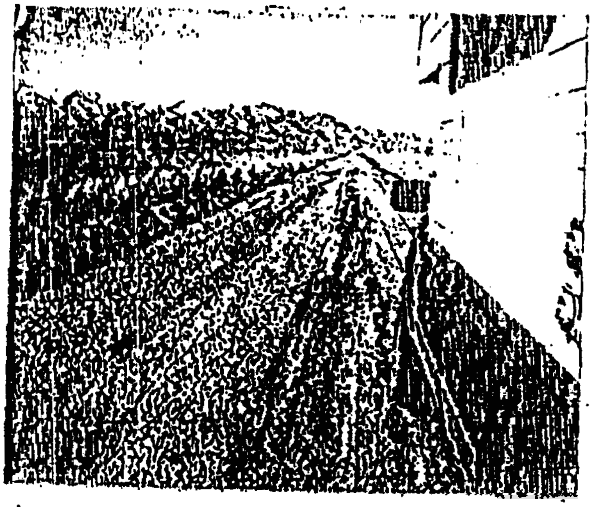
To prevent cross-contamination, all reusable sampling equipment that comes in contact with the waste will be cleaned as follows:

1. Spray equipment with a nonphosphate detergent/DI water solution
2. Rinse with deionized water
3. Air dry all equipment
4. Wrap cleaned equipment in aluminum foil

MAP OF SAMPLING LOCATION
(N/A if not applicable)

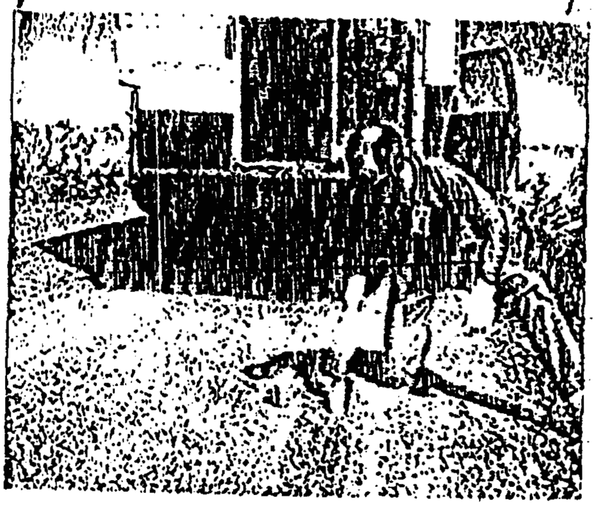


RECORDED BY: READ AND UNDERSTOOD BY:

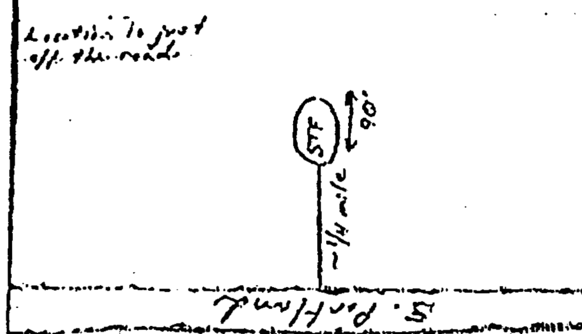


NRF

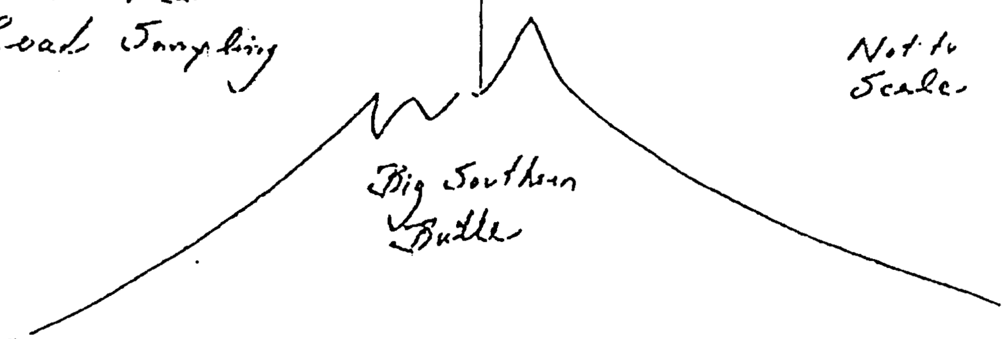
Fire Station



S-77 PCB
Road Sampling



Not to Scale



RECORDED BY: [signature] READ AND UNDERSTOOD BY: R. Rice

(3)

EPA REGION III RISK-BASED CONCENTRATION TABLE:
TECHNICAL BACKGROUND INFORMATION

originally developed by Roy L. Smith, Ph.D., Toxicologist
revised 4/12/99 by Jennifer Hubbard, Toxicologist

Development of Risk-Based Concentrations

General

Separate carcinogenic and non-carcinogenic risk-based concentrations were calculated for each compound for each pathway. The concentration in the table is the lower of the two, rounded to two significant figures. The following terms and values were used in the calculations:

Exposure variables	Value	Symboll
General:		
Carcinogenic potency slope oral (risk per mg/kg/d):	*	CPSo
Carcinogenic potency slope inhaled (risk per mg/kg/d):	*	CPSi
Reference dose oral (mg/kg/d):	*	RfDo
Reference dose inhaled (mg/kg/d):	*	RfDi
Target cancer risk:	1e-06	TR
Target hazard quotient:	1	THQ
Body weight, adult (kg):	70	BWa
Body weight, age 1-6 (kg):	15	BWc
Averaging time carcinogens (d):	25550	ATc
Averaging time non-carcinogens (d):	ED*365	ATn
Inhalation, adult (m3/d):	20	IRAa
Inhalation, child (m3/d):	12	IRAc
Inhalation factor, age-adjusted (m3-y/kg-d):	11.66	IFAadj
Tap water ingestion, adult (L/d):	2	IRWa
Tap water ingestion, age 1-6 (L/d):	1	IRWc
Tap water ingestion factor, age-adjusted (L-y/kg-d):	1.09	IFWadj
Fish ingestion (g/d):	54	IRF
Soil ingestion, adult (mg/d):	100	IRSa
Soil ingestion, age 1-6 (mg/d):	200	IRSc
Soil ingestion factor, age adjusted (mg-y/kg-d):	114.29	IFSadj
Residential:		
Exposure frequency (d/y):	350	EFr
Exposure duration, total (y):	30	EDtot
Exposure duration, age 1-6 (y):	6	EDc
Volatilization factor (L/m3):	0.5	K
Occupational:		
Exposure frequency (d/y):	250	EFo
Exposure duration (y):	25	EDo
Fraction of contaminated soil ingested (unitless)	0.5	FC

Sources: I = IRIS H = HEAST A = HEAST-Alternate W = Withdrawn from IRIS or HEAST
E = EPA NCEA provisional value O = other

Basis: C = Carcinogenic effects N = Noncarcinogenic effects I = RBC at HI of 0.1 < RBC-c

Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Soil Residential mg/kg
PARAQUAT DICHLORIDE	1910425	4.50E-003 I					1.6E+002 N	1.6E+001 N	6.1E+000 N	9.2E+003 N	3.5E+002 N
PARATHION	56382	6.00E-003 H					2.2E+002 N	2.2E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N
**PENTACHLOROBENZENE	608935	8.00E-004 I					2.9E+001 N	2.9E+000 N	1.1E+000 N	1.6E+003 N	6.3E+001 N
**PENTACHLORONITROBENZENE	82688	3.00E-003 I	2.60E-001 H				2.6E-001 C	2.4E-002 C	1.2E-002 C	2.2E+001 C	2.5E+000 C
PENTACHLOROPHENOL	87865	3.00E-002 I	1.20E-001 I				5.6E-001 C	5.2E-002 C	2.6E-002 C	4.8E+001 C	5.3E+000 C
PERMETHRIN	52645531	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N
PHENOL	108952	6.00E-001 I					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N
M-PHENYLENEDIAMINE	108452	6.00E-003 I					2.2E+002 N	2.2E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N
O-PHENYLENEDIAMINE	95545		4.70E-002 H				1.4E+000 C	1.3E-001 C	6.7E-002 C	1.2E+002 C	1.4E+001 C
P-PHENYLENEDIAMINE	106503	1.90E-001 H					6.0E+003 N	6.9E+002 N	2.6E+002 N	3.9E+005 N	1.5E+004 N
2-PHENYLPHENOL	90437		1.90E-003 H				3.5E+001 C	3.3E+000 C	1.7E+000 C	3.0E+003 C	3.4E+002 C
PHOSPHINE	7803512	3.00E-004 I		8.60E-005 I			1.1E+001 N	3.1E-001 N	4.1E-001 N	6.1E+002 N	2.3E+001 N
PHOSPHORIC ACID	7664382			2.90E-003 I				1.1E+001 N			
PHOSPHORUS (WHITE)	7723140	2.00E-005 I					7.3E-001 N	7.3E-002 N	2.7E-002 N	4.1E+001 N	1.6E+000 N
P-PHTHALIC ACID	100210	1.00E+000 H					3.7E+004 N	3.7E+003 N	1.4E+003 N	2.0E+006 N	7.8E+004 N
PHTHALIC ANHYDRIDE	85449	2.00E+000 I		3.43E-002 H			7.3E+004 N	1.3E+002 N	2.7E+003 N	4.1E+006 N	1.6E+005 N
POLYBROMINATED BIPHENYLS		7.00E-006 H	8.90E+000 H				7.5E-003 C	7.0E-004 C	3.5E-004 C	6.4E-001 C	7.2E-002 C I
POLYCHLORINATED BIPHENYLS	1336363		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C
AROCLOR-1016	12674112	7.00E-005 I	7.00E-002 I		7.00E-002 I		9.6E-001 C I	8.9E-002 C I	4.5E-002 C I	8.2E+001 C I	5.5E+000 N
AROCLOR-1221	11104282		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C
AROCLOR-1232	11141165		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C
AROCLOR-1242	53469219		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C
AROCLOR-1248	12672296		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C
AROCLOR-1254	11097691	2.00E-005 I	2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C I
AROCLOR-1260	11096825		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C
POLYCHLORINATED TERPHENYLS	61788338		4.50E+000 E				1.5E-002 C	1.4E-003 C	7.0E-004 C	1.3E+000 C	1.4E-001 C
POLYNUCLEAR AROMATIC HYDROCARBONS:											
**ACENAPHTHENE	83329	6.00E-002 I				y	3.7E+002 N	2.2E+002 N	8.1E+001 N	1.2E+005 N	4.7E+003 N
**ANTHRACENE	120127	3.00E-001 I				y	1.8E+003 N	1.1E+003 N	4.1E+002 N	6.1E+005 N	2.3E+004 N
BENZ[A]ANTHRACENE	56553		7.30E-001 E				9.2E-002 C	8.6E-003 C	4.3E-003 C	7.8E+000 C	8.7E-001 C
BENZO[B]FLUORANTHENE	205992		7.30E-001 E				9.2E-002 C	8.6E-003 C	4.3E-003 C	7.8E+000 C	8.7E-001 C
BENZO[K]FLUORANTHENE	207089		7.30E-002 E				9.2E-001 C	8.6E-002 C	4.3E-002 C	7.8E+001 C	8.7E+000 C
BENZO[A]PYRENE	50328		7.30E+000 I		3.10E+000 E		9.2E-003 C	2.0E-003 C	4.3E-004 C	7.8E-001 C	8.7E-002 C
CARBAZOLE	86748		2.00E-002 H				3.3E+000 C	3.1E-001 C	1.6E-001 C	2.9E+002 C	3.2E+001 C
CHRYSENE	218019		7.30E-003 E				9.2E+000 C	8.6E-001 C	4.3E-001 C	7.8E+002 C	8.7E+001 C
DIBENZ[A,H]ANTHRACENE	53703		7.30E+000 E				9.2E-003 C	8.6E-004 C	4.3E-004 C	7.8E-001 C	8.7E-002 C
DIBENZOFURAN	132649	4.00E-003 E				y	2.4E+001 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N
FLUORANTHENE	206440	4.00E-002 I					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N
**FLUORENE	86737	4.00E-002 I				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N
INDENO[1,2,3-C,D]PYRENE	193395		7.30E-001 E				9.2E-002 C	8.6E-003 C	4.3E-003 C	7.8E+000 C	8.7E-001 C
2-METHYLNAPHTHALENE	91576	2.00E-002 E				y	1.2E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N
**NAPHTHALENE	91203	2.00E-002 I		9.00E-004 I		y	6.5E+000 N	3.3E+000 N	2.7E+001 N	4.1E+004 N	1.6E+003 N
**PYRENE	129000	3.00E-002 I				y	1.8E+002 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N
PROMETON	1610180	1.50E-002 I					5.5E+002 N	5.5E+001 N	2.0E+001 N	3.1E+004 N	1.2E+003 N
PROMETRYN	7287196	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N

Lockheed
Idaho Technologies Company

INTERDEPARTMENTAL COMMUNICATION

Date: December 20, 1994

To: R. S. Rice, MS 4110

From: C. O. Doucette, MS 3953 Cal

Subject: COMMENTS ON ABBREVIATED SAMPLING AND ANALYSIS PLAN FOR SAMPLING OF INEL ROADS FOR PCBs (EMS-114-94) - COD-06-94

Please make the following changes to the subject document. Then you can either forward the signature page for my signature or receive my approval per telecon. Thank you for your efforts.

1. In order to identify the documented source of the concern, please replace Section 2.1 with the following:

   "During the conduct of the Environmental Baseline Survey stained soil was noted on several site roads. The staining was documented on New Site Identification Forms. The roadways are being sampled to determine if any PCBs are present as interviews with site personnel indicate that PCB contaminated oil may have been used on roadways as a dust inhibitor. Samples will be collected in response to C. Doucette's request." ✓

2. In Section 2.4, please revise the sentence to read as follows:

   "Data, acquired in accordance with the requirements specified in Section 3.1, will be used to determine if the roadways are stained with PCBs."

3. In Section 2.8, please add the following sentence at the end of the 1st paragraph:

   "The depth of the sampling will be representative of the depth of the stain, but no deeper than one foot." ✓

4. In Section 2.8, please add the following sentence at the end of the 2nd paragraph:

   "Waste disposal is discussed in Section 6."

5. In Section 2.9, the description for Sample ID 11294032PC should be "NRF Road (Duplicate)."

6. No background samples will be required.

7. In Section 4.2, change "Cal Doucette" to "Susan Burns."

(7)

SPECIAL REQUEST INFORMATION LOG

Customer: C. O. Doucette C.O. Doucette

Customer phone: 6-8113/6-9382

Charge number: 3XLA81130

Date of request: 11-15-94

Date need completed by:

Request (describe): Take representative field screen/samples from stains on the following four dirt roads: 1) Between US RTE 20 and the East Butte; 2) Between Portland and STF; 3) Between Lincoln and NRF (North of turnoff); and 4) Fire Training Center Road.

List quality control requirements (duplicates, rinsates, etc.):

EM recommended

List analyses/methods and any special detection limits required:

EM recommended

Is special equipment needed to access sample material - keys, ladders, wrenches, etc?	No
Is the sample location in a radiation, controlled or contaminated area?	No
Is special personal protective equipment or training necessary?	No
Is a radiological work permit (RWP) or safe work permit (SWP) required?	No
Will industrial hygiene or radiological control coverage be required?	IH-Yes
If applicable, have outage requests and excavation permits been obtained?	N/A

If you need help completing this form, please contact Environmental Monitoring's Donna Haney (yhd) or Randy Rice (rr5) or call 6-4189.

8

Based on the priority of this job and existing identified backlog of work we estimate completion of this work/correction of this deficiency by:

b.) Other action (Please explain): Roger Cushman thought this job might be a fill-in project since it would take 4 or less hours to complete.

<<<<==================== E N D O F F O R M ==================>>>>

a ICFA - MAINTENANCE WORK REQUEST - DEFICIENCY REPORT F

MSG FROM: YHO --INELUM1 TO: SOO --INELUM1 04/03/95 15:18:23
To: WJB --INELUM1 W J Becker
cc: YHO --INELUM1 D F Haney RA6 --INELUM1 A Rice
SOO --INELUM1 S M Burns

FROM: DONNA F HANEY
Subject: EMS-115-94

Bill: Randy and I collected the suspected PCB-contaminated road soils today at NRF, STF and the Fire Station. We tried to locate the East Butte road stains but didn't have any luck identifying these. Were these only identified from the air? The reason I'm asking is that there is lava material in several spots that is dark and might appear to be stains from the air. Please let us know if the East Butte road samples should be deleted or if you think we've overlooked. We'd like to ship these out tomorrow. Thanks!

P.S. When is the PCB class?

EMS-115-94
MSG FROM: SOO --INELUM1 TO: YHO --INELUM1 04/07/95 15:19:31
To: YHO --INELUM1 D F Haney

FROM: SUSAN M BURNS
WAC, MS 3953
526-9382 FAX 526-9473
Subject: EMS-115-94
Contact Gail Lewis-Kido (glk). She was on the original Environmental Baseline Survey Team. Alternate contacts are Jim Lane, Mona Dunihoo, or Scott Lebow. Let me know if you still can't find them. Good luck.

*** Forwarding note from YHO --INELUM1 04/07/95 14:28 ***
To: SOO --INELUM1 S M Burns
cc: YHO --INELUM1 D F Haney RA6 --INELUM1 A Rice

FROM: DONNA F HANEY
Subject: EMS-115-94

Bill doesn't know anything about the East Butte road - do you? Should we delete from the plan or do you know someone who could find the stains?

*** Forwarding note from YHO --INELUM1 04/03/95 15:18 ***
To: WJB --INELUM1 W J Becker
cc: YHO --INELUM1 D F Haney RA6 --INELUM1 A Rice
SOO --INELUM1 S M Burns

FROM: DONNA F HANEY
Subject: EMS-115-94

need to stabilize the poultry wastes before disposing of them on the land as crop fertilizer.

Acknowledgements

We thank Mrs. A. Ighodalo for providing poultry wastes and Dr. J. A. I. Omueti for his interest in this work.

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Waste Management & Research (1994) 12, 173–194

9

BIOREMEDIATION OF PETROLEUM- AND CREOSOTE-CONTAMINATED SOILS: A REVIEW OF CONSTRAINTS

Simon J. T. Pollard*[1], Steve E. Hrudey*[2] and Phillip M. Fedorak†

* *Environmental Health Program, Department of Health Services Administration and Community Medicine and † Department of Microbiology, University of Alberta, Edmonton, Alberta, Canada, T6G 2G3.*

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The evaluation and selection of technologies for the effective remediation of hydrocarbon-contaminated sites requires careful consideration of the waste/site/soil characteristics that determine their ultimate success. The presence of weathered hydrocarbon wastes and sub-optimal environmental conditions places technical restraints on the bioremediation of polynuclear aromatic hydrocarbon-contaminated soils. A brief overview of applicable bioremediation technologies is followed by an in-depth critical evaluation of limiting factors that can influence the efficacy of bio-treatment options, including waste composition, temperature, substrate, bioavailability, accompanying toxicants and soil structure.

Key Words—Creosote wood-preserving wastes, petroleum wastes, polynuclear aromatic hydrocarbons, bioremediation, constraints, weathered composition, bioavailability, salinity, toxic metals, soil texture, climatic conditions.

1. Introduction

Contaminated land resulting from previous industrial activity is now widely recognized as a potential threat to environmental health and its continual discovery over recent years has led to international efforts to restore contaminated soils and aquifers (Smith 1988, Hrudey & Pollard 1993). Current strategies for site clean-up emhasize on-site/*in-situ* treatment technologies that can be linked together in a process train of physico-chemical and/or biological methods capable of tackling a range of multi-media contamination (Sims 1990). This approach recognizes that application of a single technology alone is usually insufficient for effective site remediation.

Bioremediation is one component of the process train approach finding increasing application for hydrocarbon-contaminated soils. This process option has generated growing interest because of its reported cost-effectiveness. Bioremediation has been successfully applied at a number of coal-tar, petroleum and creosote hazardous waste sites in Europe (Bewley *et al.* 1990, Ellis *et al.* 1991) and North America (Piontek 1989, McGinnis *et al.* 1991, Hinchee *et al.* 1991). The presence of hydrocarbon contamination alone, however, is insufficient justification for the application of bioremediation.

Soil contamination at petroleum and wood-preserving sites has received increasing attention across Canada (CCREM 1988, CCME 1991*a,b*) because the contaminants

[1] Currently, Lecturer, Environmental Chemistry, Chemistry Department, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh, EH9 3JJ, UK.
[2] Author to whom correspondence should be addressed.

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frequently identified include polynuclear aromatic hydrocarbons (PAHs), BTEX compounds (benzene, toluene, ethylbenzene and xylenes), biocidal organics (pentachlorophenol, 2,4,6-trichlorophenol) and a range of toxic metals associated with refining and wood treatment operations (e.g. As, Cr, Cu, Pb and Ni). An exhaustive review of the bioremediation literature (Pollard & Hrudey 1992), coupled with an examination of waste/site/soil characteristics at several sites in Alberta (Pollard *et al.*1992, 1993) has highlighted a number of constraints that may reduce treatment efficacy at sites chronically exposed to hydrocarbon contamination. The purpose of this paper is to present a critical evaluation of the potential constraints on bioremediation technologies at petroleum and creosote wood-preserving facilities such that remediation specialists may be aware of these factors and design treatment process trains that can incorporate them accordingly.

The application and ultimate success of remedial measures is determined by a multitude of waste/site/soil characteristics and the interactions among them. These factors demand that evaluation of the potential applicability of treatment technologies is made on an individual site basis. Our discussion is largely focused on PAH bioremediation because the documented carcinogenicity of certain compounds in this group has resulted in relatively demanding clean-up criteria (Moen 1988, ATSDR 1990, CCME 1991*b*). Furthermore, the persistence of these compounds in the soil environment has been demonstrated consistently (Edwards 1983, Jones *et al.* 1989*a,b*, Wild *et al.* 1991).

2. Overview of bioremediation technologies

Biological treatment methods for the reclamation of contaminated land may be classed into four categories: *in situ* bioremediation; enhanced land treatment; slurry bioreactors; and bioventing. The first three technologies are applicable to the remediation of PAH-contaminated soils, while the last is limited to volatile organic compounds amenable to aerobic biotransformation (Long 1992). Here, we present a brief overview of these technologies, but this is a rapidly developing research field and biological soil treatment technologies are continually under refinement. For greater detail, the reader is referred to the many excellent reviews on the fundamental technical and microbiological aspects of bioremediation strategies (Lee *et al.* 1988, Morgan & Watkinson 1989*a,b*, Sims *et al.* 1990, Grady 1990, Madsen 1991, Ryan & Loehr 1991).

2.1 In situ *bioremediation*

The objective of *in situ* bioremediation is to stimulate the activity of the hydrocarbon-degrading microbial population in the subsurface vadose and saturated zones. This is achieved through the addition and management of oxygen and nutrients in a controlled, closed-loop system (Hopper 1989). Amendments (nutrients, electron acceptor and primary substrate) used to aid stimulation and maintenance of biological activity, are introduced up-gradient of the contaminated zone using wells, infiltration galleries or natural fractures in the underlying strata. Soluble transformation by-products, mobilized contaminant and unused nutrients are transported by diffusion and advection down-gradient to the recovery system. At the surface, they are treated and re-injected to recharge the contaminated zone. Site management of oxygen, nutrients and the water regime serves to contain hydraulically the contaminated zone. In this manner, off-site migration of mobile contaminants or potentially harmful metabolites is prevented.

For most circumstances, the principal factor limiting the rate of *in situ* bioremediation is the supply of amendments to the subsurface microbial population (Lee *et al.* 1988). Sites exhibiting subsurface saturated horizontal conductivities of less than $10^{-6}\,m\,s^{-1}$ (Thomas *et al.* 1987) are not considered amenable to this technology because of the retardation of mass transport mechanisms that are necessary for effective delivery of the amendments. Successful treatment relies on the degree of hydraulic control afforded by the delivery-recovery system. Without continual delivery of amendments and removal of metabolites, the system may become biologically inactive at one extreme or clogged with biomass because of excessive microbial activity at the other extreme. Only soluble transformation products will be recovered from the contaminated zone and poorly soluble metabolites, some of which may be toxic, may readsorb to the soil matrix. Soil washing with surfactant is therefore being used increasingly for the mobilization of trapped or adsorbed contaminants (Mahaffey *et al.* 1991).

2.2 Enhanced land treatment

Unfavourable environmental conditions that restrain *in situ* bioremediation, such as low operating temperatures, anoxic soil horizons and low or variable hydraulic conductivities, are often addressed in enhanced land treatment using an aerobic, on-site prepared-bed system. Enhanced land treatment methods have been used to successfully treat a wide variety of petroleum- and creosote-contaminated soils (Bartha & Bossert 1984, Bartha 1986, Visscher *et al.* 1990, Ellis *et al.* 1991).

Contaminated soil is excavated and amended with water, nutrients, electron acceptor, lime for pH adjustment and primary substrate and then returned to a lined land treatment unit fitted with a leachate collection and recirculation system (Sims 1990). Seed organisms may be used to enhance initial transformation rates. However, the ability of bacterial inocula to advance PAH degradation requires the imported organisms to compete and survive alongside the autochthonous population (Atlas 1977, Leahy & Colwell 1990). Covered treatment facilities allow the control of volatiles, temperature and the water regime within the unit. Tilling, together with the addition of straw, wood chips or similar organic matter controls soil tilth and enhances the aeration status of the soil/waste mixture. Performance monitoring should be conducted using a mass balance approach. This requires careful accounting for contaminant disappearance. Bioassay response data are necessary to demonstrate an overall change in toxicity of soil contaminants (Aprill *et al.* 1990).

2.3 Slurry bioreactors

Bioreactors for the controlled biotransformation of refractory pollutants are a recent development although the underlying biotechnology and process control technology is well understood (Visscher *et al.* 1990). Soil is treated as an aqueous slurry in a closed reactor using a well characterized and seeded microbial population. Process control allows reduced treatment times relative to *in situ* or enhanced land treatment methods. Consequently, slurry bioreactors are being considered for the treatment of clayey soils and for situations in which field temperatures adversely affect biotransformation rates. Reactors may be operated in the aerobic or anaerobic mode although the anaerobic microbial population is generally less flexible in adapting to changes in substrate availability and is less tolerant of inhibitory toxic metals (Kirk & Lester 1991).

(c) the presence of heterogeneous subsurface conditions, which are difficult to characterize; and

(d) sub-optimal environmental conditions for on-site and *in situ* treatment.

In addition, expensive analytical procedures are required for the reliable performance monitoring of treatment processes. Typically, hydrocarbon contamination has to be quantified by oil and grease (solvent-extractable material) or total petroleum hydrocarbon measures. The presence of solvent-extractable organic material at hydrocarbon-contaminated sites provides insufficient evidence, by itself, to justify proposing bioremediation technologies. Remedial technology selection requires a rational review of the process capabilities, limitations and site-specific constraints to insure cost-effective use of clean-up funds.

3.1 *Waste composition*

3.1.1 *Hydrocarbon wastes*

The chemical composition of hydrocarbon wastes can vary substantially depending on the nature (natural or synthetic crude, coal-tar creosote, carrier oil), composition (e.g. paraffinic, naphthenic, aromatic or intermediate crude oil), degree of processing of the source material (light naphtha, kerosene, residual fuel oil) and the extent of weathering experienced by the exposed waste product (Nyer & Skladany 1989). Petroleum hydrocarbons have historically been classified according to four generic classes; the saturates (*n*-alkanes, branched alkanes, cycloparaffins), the aromatics (mono, di and polynuclear), the resins (pyridines, quinolines, carbazoles, sulphoxides and amides) and the asphaltenes (polyhydric phenols, fatty acids, ketones, esters, metalloporphyrins, polymeric naphthenic ring compounds) (Speight 1984, Leahy & Colwell 1990). Petroleum composed of significant proportions of the latter two classes are generally characteristic of "heavy" oils (Tissot & Welte 1984).

Coal-tar creosote represents a secondary distillation product of gasified coal, in which the main chemical classes are the homocyclic polynuclear aromatics ($\sim 85\%\ ^{w}/_{w}$), the heterocyclic polyaromatics ($\sim 3\%\ ^{w}/_{w}$) and the phenols ($\sim 12\%\ ^{w}/_{w}$) of various degrees of substitution (Mueller *et al.* 1989*a*). The chemical complexity of all fossil fuels, including refined products, is extreme. Process residues such as coal tar, pitch and still bottoms may typically contain several thousand individual components (Drake & Jones 1983, Enzminger & Ahlert 1987). The waste streams from auxiliary unit operations, the residues of secondary process chemicals, carrier oils associated with wood treating solutions, biotransformation products from the decomposition of hydrocarbons and wood fragments and alternative wood preservatives and process chemicals used on site will all contribute additional complexity to the residual contamination encountered in the soil.

3.1.2 *Weathered wastes and recalcitrance*

Hydrocarbon wastes that have been chronically exposed to soil over decades present additional difficulties for biological treatment. Weathering processes such as evaporation, photolytic loss, hydrolysis and biotransformation, selectively reduce the concentration of easily degradable substrates leaving behind refractory residues that resist further microbial attack (Bossert & Bartha 1984). Many residual compounds possess low Henry's Law constants (K_H), high octanol-water (K_{ow}) and high soil organic carbon-water (K_{oc}) partition coefficients. Such residues are usually non-volatile or semi-volatile

and they partition preferentially to the residual oil phase, to soil organic matter (SOM) and to solid surfaces. For growth on hydrocarbons, microorganisms require an aqueous phase, at least at the microscopic level, in which these substrates are dissolved. Thus, because of the unfavourable partition coefficients for many common contaminants, the bioavailability of these constituents is severely restricted (Smith *et al.* 1989, Mihelcic & Luthy 1991).

The microbial transformations of hydrocarbons in the soil environment have been thoroughly and regularly reviewed (Atlas 1981, Cerniglia 1984*a*,*b*, Bartha 1986, Leahy & Colwell 1990, Cerniglia 1993). Soil microorganisms display an impressive diversity in their metabolic capabilities and microbiologists continue to isolate and characterize soil microorganisms capable of utilizing petroleum and creosote waste components as carbon and/or energy sources (Mueller *et al.* 1989*b*, 1990a,b, Kelly & Cerniglia 1991). Susceptibility to biotransformation is a function of chemical structure, the degree and nature of substitution of the parent compound and, more generally, molecular weight. The following generalized sequence of decreasing susceptibility to biotransformation among chemical classes has been reported (Atlas & Bartha 1987, Leahy & Colwell 1990): *n*-alkanes > branched chain alkanes > branched alkenes > low molecular weight *n*-alkyl aromatics > monoaromatics > cyclic alkanes, polynuclear aromatics > > > asphaltenes. Compounds in petroleum or coal-tar creosote are intimately mixed and co-dissolved, a circumstance that may influence the rates of biotransformation of individual components in a positive or negative sense (Bartha 1986).

While the biotransformation of *n*-alkanes (Watkinson & Morgan 1990), aromatic hydrocarbons (Arvin *et al.* 1989, Heitkamp *et al.* 1988) and certain heterocyclic components of hydrocarbon wastes (Fedorak & Westlake 1984*a*,*b*) has been demonstrated, many authors have noted the refractory nature of the asphaltenes (Westlake *et al.* 1974, Bossert & Bartha 1984, Semple *et al.* 1990). Westlake *et al.* (1974) observed changes in the chemical composition of four crude oils towards the asphaltene and heterocyclic component classes following microbial utilization by a mixed culture over a 10-day period. Increases in the asphaltene content of weathered oils suggest that during biotransformation, other petroleum fractions are transformed into asphaltenes. Such changes apparently occur via free-radical initiated polymerizations to yield cross-linked, high molecular weight residues (Bossert & Bartha 1984). Huddleston & Cresswell (1977) noted for an oil initially containing $22\%\ ^{w}/_{w}$ paraffins, $28\%\ ^{w}/_{w}$ aromatics and $50\%\ ^{w}/_{w}$ resin-asphaltenes, that $82\%\ ^{w}/_{w}$ of the paraffins, $60\%\ ^{w}/_{w}$ of aromatics but only $1\%\ ^{w}/_{w}$ of the resin-asphaltenes fraction of the oil were lost over a 22-month period during land treatment. These observations suggest that only a small fraction of heavy asphaltic-naphthenic oils are biotreatable within a realistic time frame (Bartha 1986). These are prominent constituents of residuum pits and flash pits at many petroleum-contaminated sites and are key components in Bunker C residual fuel oil, widely used for the delivery of coal-tar creosote to untreated timber at wood-treatment facilities (Pollard & Hrudey 1992).

Investigations into the persistence of heavy oil constituents in soil microcosms including N-, S- and methyl-substituted PAH indicated that certain components (acridine, carbazole and dibenzothiophene) and their immediate biotransformation products are also among persistent components of heavy oil wastes and they could serve as indicators of residual soil contamination (Bulman *et al.* 1990, Hosler *et al.* 1991). This research has underscored the need in treatability studies to distinguish biotransformation (conversion of parent compound to another organic compound) from mineralization (conversion of the substrate to CO_2, H_2O and inorganic ions).

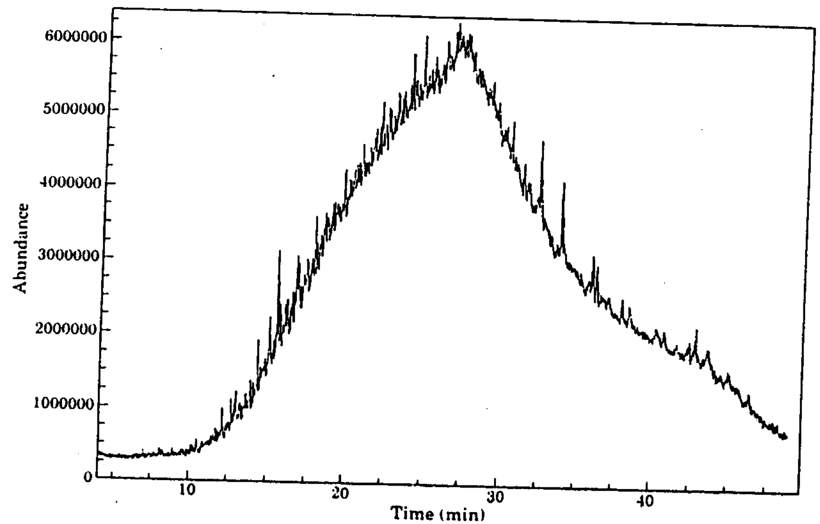

Fig. 2. Gas chromatogram of a solvent extract of weathered oil-contaminated soil.

The broad unresolved hump, characteristic to the gas chromatograms of many weathered oils (Fig. 2) has been attributed to the presence of a complex of linear long-chain alkanes (Gough & Rowland 1990) and the alicyclic alkanes including the hopanes, steranes and diasteranes. These are also proposed as indicators of residual petroleum contamination (Atlas 1981, Volkman *et al.* 1992).

Co-oxidation is frequently cited as an important mechanism for the degradation of recalcitrant substrates in the soil environment (Sims & Overcash 1983, Keck *et al.* 1989). For the high molecular weight PAH (>4 rings), co-oxidation may be a major degradation mechanism. Co-oxidation occurs when an organism growing on a particular substrate gratuitously oxidizes another substrate from which it is unable to obtain either carbon or energy (Atlas & Bartha 1987). Relationships of this kind have been used to explain discrepancies between recorded half-lives in single compound and mixed waste studies (Sims *et al.* 1987) and this phenomenon may contribute to the observed differences in apparent degradation rates between fresh and weathered wastes in soils (Gauger *et al.* 1990).

Biotransformation has been demonstrated for soil-bound components within the phenolic, heteroaromatic and polynuclear aromatic fractions of coal-tar creosote (Arvin *et al.* 1989, Mueller *et al.* 1989*a*, 1991*a,b*). A significant portion of the water-soluble fraction (BTEX, 2-3 ring PAH, phenols and low molecular weight heterocyclic compounds) is potentially degradable in contrast to the ⩾4 ring PAH, dibenzothiophenes, trimethylphenols, pyrrole and the tetra- and pentamethylcarbazoles that resist microbial attack. (Mueller *et al.* 1991*b*) have stressed that substantial biodegradation of high molecular weight PAH and other carcinogenic components in creosote-contaminated soils and sediments is integral to effective site remediations. Soil used in a solid-phase bioremediation (enhanced land treatment) study by these workers was contaminated with a mixture of creosote/PCP to 1% by weight. Treatment was stimulated by nutrient supplementation, tilling and incubation at 23°C over a 12-week period. The differing PAH profiles of contaminated surficial soils (weathered) and contaminated (unaged) sediments were illustrative of potential biodegradation behaviour. Generalized patterns of biodegradation were consistent with the existing literature; phenols > low molecular weight heterocyclics > low molecular weight PAH > high molecular weight PAH > PCP. Microbial activity toward PAH components in the unamended unaged sediment-bound wastes began only after extensive degradation of the creosote phenols was observed. Mueller *et al.* (1991*b*) expressed doubt over the utility of land treatment for the effective remediation of weathered creosote contaminated soils at the Pensacola, Florida site.

3.2 *Temperature-climatic considerations*

Each microorganism possesses a growth temperature range over which it can remain active. Cessation of activity occurs at a minimum temperature because membrane gelling stops transport of nutrients and waste products across the cell membrane. At a maximum temperature, protein denaturation results in enzyme dysfunction, deterioration of the cell membrane, and ultimate thermal death (Brock & Madigan 1988). Furthermore, widely fluctuating seasonal and diurnal temperatures are generally unfavourable to the maintenance of a stable, active hydrocarbon-degrading microbial population.

Temperature has a marked influence on equilibrium (partition) and kinetic (rate) constants as described by van't Hoff isochore and Arrhenius equations respectively. Temperature also affects the viscosity and aqueous solubility of hydrocarbons. The reported optimum temperature range for the biodegradation of petroleum is 30–40°C (Bossert & Bartha 1984, Leahy & Colwell 1990) although site specific conditions may play a role in selecting a soil population with a lower optimal temperature (Morgan & Watkinson 1989*b*). Atlas (1981) reports petroleum degradation rates an order of magnitude slower at 5°C. Furthermore, at low temperatures, the volatilization of low molecular-weight hydrocarbons is significantly reduced. These solvent compounds (C_5–C_{10}) are widely held to be inhibitors of hydrocarbon degradation, at high concentration, because of their capacity to disrupt the phospholipid membrane (Atlas 1981, Pfaender & Buckley 1984, Leahy & Colwell 1990, Watkinson & Morgan 1990).

Climatic considerations are important in the design and operation of enhanced land treatment systems in that they indicate management requirements for temperature and water regimes within the treatment bed. Modifications and control of soil temperature can be achieved by irrigation to increase the soil heat capacity or the addition of mulches to reduce diurnal and seasonal temperature fluctuations (Dupont *et al.* 1988). Decreasing temperature also increases oily waste viscosity. Under low temperature conditions, wastes become increasingly viscous and extremely difficult to mix. If year-round treatment is to be provided, heating and temperature control costs could substantially increase land treatment costs.

The effect of temperature (10–30°C) on PAH persistence was studied by Coover & Sims (1987*a*) in unacclimated agricultural sandy loam soil. They found temperature was not the primary constraint for the biotransformation of high molecular weight PAHs. In their study, 50–89% by weight of these compounds remained following a 240-day study at 30°C. At 10°C, 73–93% by weight of these PAHs remained. In contrast, the lower molecular weight (<4 ring) analogues showed appreciable increases in apparent

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Agency for Toxic Substances and Disease Registry

Public Health Statement

PCBs

ATSDR Public Health Statement, June 1989

What are PCBs?

The abbreviation PCB refers to polychlorinated biphenyls. PCBs are a family of man-made chemicals that contain 209 individual compounds with varying toxicity. Commercial formulations of PCBs enter the environment as mixtures consisting of a variety of PCBs and impurities. Because of the complex nature associated with evaluating the health effects of PCBs, this document will address only seven selected classes of PCBs, which include 35% of all of the different PCBs and 98% of PCBs sold in the United States since 1970. Some commercial PCB mixtures are known in the United States by their industrial trade name, Aroclor. Because of their insulating and nonflammable properties, PCBs have been used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs stopped in the United States in October 1977 because of evidence that PCBs accumulate in the environment and may cause health hazards for humans.

How might I be exposed to PCBs?

Although PCBs are no longer manufactured, human exposure still occurs. Many older transformers and capacitors still contain fluids that contain PCBs. The useful lifetime of many of these transformers can be 30 years or more.

The two main sources of human exposure to PCBs are environmental and occupational. PCBs are very persistent chemicals that are widely distributed throughout the entire environment. PCBs have been found in at least 216 of 1177 hazardous waste sites on the National Priorities List (NPL). Background levels of PCBs can be found in the outdoor air, on soil surfaces, and in water. Eating contaminated fish can be a major source of PCB exposure to humans. These PCBs originate in contaminated water, sediment, PCB-laden particulates, and in fish that have eaten PCB-contaminated prey. Although PCBs found in fish are generally concentrated in nonedible portions, the amounts in edible portions are high enough to make consumption a major source of exposure for humans. Compared with the intake of PCBs through eating contaminated fish, exposure through breathing outdoor air containing PCBs is small. Most of the PCBs in outdoor air may be present because of an environmental cycling process. PCBs in water, or on soil surfaces, evaporate and are then returned to earth by rainfall or settling of dust particles. Reevaporation repeats the cycle. Once in the air, PCBs can be carried long distances; they have been found in snow and seawater in the Antarctic. In addition, contaminated indoor air may be a major source of human exposure to PCBs, particularly in buildings that contain PCB-containing devices.

PCBs can be released into the environment from:

- poorly maintained toxic waste sites that contain PCBs,
- illegal or improper dumping of PCB wastes, such as transformer fluids,
- leaks or fugitive emissions from electrical transformers containing PCBs, and
- disposal of PCB-containing consumer products into municipal landfills rather than into landfills designed to hold hazardous wastes.

Consumer products that may contain PCBs are:

- old fluorescent lighting fixtures and
- electrical devices or appliances containing PCB capacitors made before PCB use was stopped.

Occupational exposure to PCBs can occur during:

- repair or maintenance of PCB transformers,
- accidents or spills involving PCB transformers,
- disposal of PCB materials, and
- contact at hazardous waste sites.

How do PCBs get into my body?

PCBs enter the body through contaminated food and air and through skin contact. The most common route of exposure is by eating fish and shellfish from PCB-contaminated water. Exposure from drinking water is minimal. It is known that nearly everyone has PCBs in their bodies, including infants who drink breast milk containing PCBs.

How do PCBs affect my health?

Although PCBs have not been manufactured in the United States since October 1977, their diminishing but continued presence in certain commercial applications and trade have resulted in low-level exposure to the general population. Prior to 1977, certain occupational settings had, and may still have, higher levels of human exposure. Animal experiments have shown that some PCB mixtures produce adverse health effects that include liver damage, skin irritations, reproductive and developmental effects, and cancer. Therefore, it is prudent to consider that there may be health hazards for humans.

The U.S. Department of Health and Human Services has determined that PCBs may reasonably be anticipated to be carcinogens. Human studies to date show that irritations, such as acnelike lesions and rashes, can occur in PCB-exposed workers. Other studies of people with occupational exposure suggest that PCBs might cause liver cancer. Reproductive and developmental effects may also be related to occupational exposure and eating of contaminated fish. While the role of PCBs in producing cancer, reproductive, and developmental effects in humans cannot be clearly delineated, the suggestive evidence provides an additional basis for public health concern about humans who may be exposed to PCBs. The complexity of relating the specific mixtures for which data are available to exposures in the general population has resulted in a tendency to regard all PCBs as having a similar health hazard potential, although this assumption may not be true.

Is there a medical test to determine if I have been exposed to PCBs?

There are tests to determine PCBs in the blood, body fat, and breast milk. These tests are not routine clinical tests, but they can detect PCBs in members of the general population as well as in workers with occupational exposure to PCBs. Although these tests indicate if one has been exposed to PCBs, they do not predict potential health effects. Blood tests are the easiest, safest, and, perhaps, the best method for detecting recent large exposures. It should be recognized that nearly everyone has been exposed to PCBs because they are found throughout the environment and that nearly all persons are likely to have detectable levels of PCBs in their blood, fat, and breast milk.

What levels of exposure have resulted in harmful health effects?

Figures 1.1, 1.2, and 1.3 on the following pages show the relationship between exposure to PCBs and known health effects. Other PCBs may have different toxic properties. In the first set of graphs, labeled "Health effects from breathing PCBs," exposure is measured in milligrams of PCBs per cubic meter of air (mg/m3). In the second and third sets of graphs, the same relationship is represented for the known "Health effects from ingesting PCBs" and "Health effects from skin contact with PCBs." Exposures are measured in milligrams of PCBs per kilogram of body weight per day (mg/kg/day). It should be noted that health effects observed by one route of exposure may be relevant to other routes of exposure.

In all graphs, effects in animals are shown on the left side, effects in humans on the right. The first column on the graphs, labeled short-term, refers to known health effects from exposure to PCBs for 2 weeks or less. The columns labeled long-term refer to PCB exposures of longer than 2 weeks. The levels marked on the graphs as anticipated to be associated with minimal risk of developing health effects are based on information generated from animal studies; therefore, some uncertainty still exists. Based on evidence that PCBs cause cancer in animals, the Environmental Protection Agency (EPA) considers PCBs to be probable cancer-causing chemicals in humans and has estimated that ingestion of 1 microgram of PCB per kilogram per day for a lifetime would result in 77 additional cases of cancer in a population of 10,000 people or equivalently, 77,000 additional cases of cancer in a population of 10,000,000 people. These risk values are plausible upper-limit estimates. Actual risk levels are unlikely to be higher and may be lower.

What recommendations has the federal government made to protect human health?

For exposure via drinking water, EPA advises that the following concentrations of PCB 1016 are levels at which adverse health effects would not be expected: 0.0035 milligrams PCB 1016 per liter of water for adults and 0.001 milligrams PCB 1016 per liter of water for children.

EPA has also developed guidelines for the concentrations of PCBs in ambient water (e.g., lakes and rivers) and in drinking water that are associated with a risk of developing cancer. The guideline for ambient water is a range, 0.0079 to 0.79 nanograms of PCBs per liter of water, which reflects the increased risk of one person developing cancer in populations of 10,000,000 to 100,000 people. The guideline for drinking water is a range, 0.005 to 0.5 micrograms of PCBs per liter of water, which also reflects the risk of one person developing cancer in populations of 10,000,000 to 100,000 people.

The Food and Drug Administration (FDA) specifies PCB concentration limits of 0.2 to 3 parts per million (milligrams PCB per kilogram of food) in infant foods, eggs, milk (in milk fat), and poultry (fat).

The National Institute for Occupational Safety and Health (NIOSH) recommends an occupational exposure limit for all PCBs of 0.001 milligram of PCBs per cubic meter of air (mg/m3) for a 10-hour workday, 40-hour workweek. The Occupational Safety and Health Administration (OSHA) permissible occupational exposure limits are 0.5 and 1.0 mg/m3 for specific PCBs for an 8-hour workday.

Where can I get more information?

If you have more questions or concerns, please contact your state health or environmental department or:

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Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road, E-29
Atlanta, Georgia  30333
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